Synthesis of Complex Gold Nanostructures via Seeded Growth

Introduction
- Gold nanostructures exhibit unique surface plasmon resonance (SPR) and other unique optical properties depending on size and shape
- Tailoring the size and specifically the shape may yield novel SPR and other optical properties

Motivation
- Several nanostructures are desired as a platform for more complex structures to be, providing a novel, unique optical signature

Simple Gold Nanoparticle Synthesis

Nanoparticle Growth: HAuCl₄ is reduced by sodium borohydride in the presence of cetyltrimethylammonium bromide (CTAB). CTAB acts as a stabilizing agent by forming a micelle around the particle, stopping further growth

Gold Nanorod Synthesis

Nanorod Growth: HAuCl₄ is partially reduced by ascorbic acid in the presence of AgNO₃, AuNPs and CTAB. The CTAB and AgNO₃ adsorb to surfaces of the AuNP which limits growth in some direction, leading to rod formation.

Polymer (PVP) Wrapping Gold Nanorods

Polymer Wrapping: The zeta potential (electrostatic potential) of gold nanorods before (E) and after wrapping (F) PVP. The change from positive to negative correlates with the change from the positively charged CTAB to the negatively charged PVP

Polymer Wrapping (PVP) of gold nanorods for use as seeds for more complex growth

Gold Nanostar Synthesis

Nanostar Growth: HAuCl₄ is reduced by a solution of dimethyl formamide (DMF) and polyvinylpyrrolidone (PVP) in the presence of AuNPs. DMF/PVP complexes allow fast growth on some surfaces, leading to ‘spike’ formation

Polymer (PVP) Wrapping Gold Nanorods

Polymer wrapping (PVP) of gold nanorods for use as seeds for more complex growth

Next Steps
- It is theorized that utilizing the PVP wrapped AuNRs as seeds in a gold nanostar growth solution will yield a nanorod with complex star like growths on either end(See the schematic below)
- Further growth from these complex particles seek to produce ring or ‘U’ shaped nanostructures via a seeded growth

Complex Nanostructure Growth: Schematic illustration of the theoretical synthesis path for the production of a complex nanostructure

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